The Role of Polydopamine Enhancing Interface Compatibility of Cellulose Reinforcement in Hydrophobic PMMA Matrix

Pieter Samyn
Ghent University, Belgium

The performance of fiber-reinforced polymer composites is determined by the interface compatibility. In particular, the hydrophilic nature of cellulose fibers dispersed in a hydrophobic matrix requires additional surface modification as traditionally done with chemical surface grafting and hazardous solvents. Taking into account the environmental friendliness of cellulose composites, however, more sustainable routes are required to operate under aqueous environment and utilization of biopolymer substitution. Therefore, the use of polydopamine as adhesive mediator has been explored in providing a general platform to functionalize cellulose fibers. In this presentation, different conformations for surface modifications of cellulose fibers with dopamine are illustrated for enhancing compatibility. This is done either by self-polymerization of polydopamine into a compatible surface layer and/or the self-assembly of dopamine functional groups into vesicular structures that are physically adsorbed at the cellulose surface. After a study on the surface adhesion of modified cellulose fibers, they were incorporated in PMMA matrix through solution casting. The local adhesive properties of the modified cellulose fibers were probed by atomic force microscopy and seem to contribute to higher interfacial shear strength. This was confirmed by the single-fiber pull out tests at macroscale indicating an optimum concentration of nanoparticles at the cellulose surface. The tensile strength and elongation at break of the composites were function of the degree of surface modification and superior to untreated fibers. In addition, the nanoparticles show colorimetric and fluorescent response to mechanical shear stresses providing an evaluation tool to explore the interface phenomena upon failure of the PMMA composite.

Biography

Pieter Samyn studied from 1996-2001 Materials Science and Engineering at Ghent University (Belgium) and completed his Ph.D. in 2007 on polymer tribology. After post-doc positions at Department of Textiles (Ghent) and Department of Microsystems Engineering (Freiburg), he was appointed as a Juniorprofessor in Bio-based Materials Engineering at University of Freiburg (2010-2016). He moved to University of Hasselt in 2016, focusing on valorization of biomass for functional biocomposites and devices. In particular, he works on the processing of bio-based composites and papers providing new surface properties and technological functionalities, in combination with analytical service tools. He is currently involved in the implementation of biobased materials in functional coating applications for industrial applications at Sirris, Belgium.

Pieter.samyn@outlook.be